Chapter 10
System Maintenance and Troubleshooting

10.1 Maintenance guidelines

10.1.1 PC Maintenance Tools

It is important to have the right tools for the job during PC Maintenance. The wrong tool could damage your PC beyond repair and cost you thousands of rupees. The tools required for maintaining your PC can be purchased from any tools shop. Tools can be divided into two categories.

10.1.1.1 Basic tools

Basic tools are required to do the simple maintenance tasks of your PC. These tools are usually not expensive and can be purchased easily. These tools include:

- Electrostatic discharger (ESD) (figure 10.1) - for discharging any static electricity on hands, cloths, tools or components. The ESD includes a wrist strap and a mat that prevents damage from static electricity to components. A grounding wire is used to discharge any built up static. It is important to use an ESD in areas where the level of humidity low because static electricity builds up in dry air.

Figure 10.1: Electrostatic Discharge strap

- Simple hand tools - such as flat blade (figure 10.2), hexagonal-headed (figure 10.5) and Phillips screwdriver (Medium and small size) (figure 10.3). It is important to use the matching screwdriver for the particular screw or else it could damage the screw or slip and damage the component. For example it is advised to use Phillips or hex screws for screwing the motherboard because using flat screws is prone to slipping. A special shaped screw called the Torx (figure 10.4) is used to make it impossible to use a flat

blade to remove this screw. Only a Torx screwdriver can be used for this purpose. Other hand tools include tweezers (figure 10.6) to grab small parts, part grabber as the name implies also to grab parts in difficult places and an IC extraction tool (figure 10.7) for removing older memory chips and BIOS chips.

Figure 10.2: Flat-Blade Screwdriver

Figure 10.3: Phillips Screwdriver

Figure 10.4: Torx Screwdriver

- Diagnostic software and Hardware - such as memory scanning software, processor testing software, hard drive testing software, network monitoring software and many more for testing system components.

- A Multimeter (figure 10.8) - for testing voltage, current and resistance, and to check continuity of cables and switches.

- Chemicals - such as contact cleaners, lens cleaners and freeze spray.

- Compressed air - for cleaning.

- Lint free cotton swabs.

- Nylon wire ties (figure 10.9) - for organizing wires.

- Flash light - preferably and high-tech LED lamp.

Figure 10.5: Hex Screwdriver

Figure 10.6: Tweezers

- Needle nosed pliers (figure 10.10) - for grabbing parts.
- Soldering iron (figure 10.11) - for simple soldering tasks.
- Wire cutters (figure 10.12) - for carryout simple maintenance of wires in your system.
- Bootable CD or floppy - to boot the system without an operating system.
- Marker pens and notepads - for taking down notes.

10.1.1.2 Advanced tools

The advanced tools are much more expensive than basic tools and are required for professional hardware repair and maintenance. The tools enable you to diagnose problems much faster and more accurately. These tools are not available in every tools shop and sometimes have to be purchased from the manufacturers.

Figure 10.7: IC Extraction Tool

Advanced tools include:

- Memory testing machines - for testing and evaluating the operation of SIMMs, DIMMs and RIMMs.
- Serial and Parallel loop back plugs - for testing serial and parallel ports.
- A network cable scanner - for testing your network cables.
- A POST card - for machines running DOS and non-windows operating systems these cards will show the results of the Power On Self Test, and also inform the IRQ and DMA usage of devices.

10.1.2 Safety

Safety is important when handling any electronic device. You need to consider your safety and the safety of the system components when handling a PC. The PC usually deals with voltages ranging from 3 volts to about 12 volts which are generally not harmful to you. The only components that can have a harmful voltage to you is the power supply which deals with 220 volts and the CRT monitor which has voltages exceeding 50,000 volts. It is not advisable to try to repair the power supply and the CRT monitor. Repairs or maintenance of the internal components of these devices should be handed over to the experts.

Figure 10.8: Multimeter

Figure 10.9: Nylon Wire Ties

The second consideration of safety as mentioned above is the safety of the components of the PC. Before doing any maintenance or repairs on the components of the PC it must be disconnected from the main power source. Modern ATX form factor machines have some amount of power when ever the system is plugged into the main power source. Therefore to

avoid harm to the power sup- ply, motherboard, processor, memory, hard disks and expansion cards etc., the PC must be unplugged form the main power source. If any of the components are plugged in or removed while the power is still on it could destroy any number of components on your PC.

Another important factor is that you must use an ESD to avoid damage caused by static electricity to the sensitive components of your PC. If an electrostatic charge is discharged through any component it could easily destroy it.

Figure 10.10: Needle-Nose Pliers

Figure 10.11: Soldering iron

It is not necessary to ground the whole PC by connecting it to an earth wire on the wall outlet, rather maintain the same electric potential on all components be connecting your ESD wrist strap to the chassis of the PC. The ESD mat must be connected to the chassis or an earth connection. Any component removed from the PC must be laid on the ESD mat so that any static electricity is discharged.

Figure 10.12: Wire Cutters

10.1.3 Preventive Maintenance

As term “preventive maintenance” implies, it is any maintenance work done to avoid problems on your PC and to keep your PC functioning perfectly and in top performance. Preventive maintenance would give your PC a longer life, better performance and protect your PC against component failure and data loss. It will also give your computer a better resale value. Preventive maintenance is categorized into two types:

1. Active - procedures that promote longer life and trouble free operation of your PC.

2. Passive - procedures which are taken to protect your PC from environmental or external factors.

10.1.3.1 Active preventive maintenance

As mentioned above active preventive maintenance procedures ensure longer and trouble free life for your PC. The frequency of indulging in an active preventive maintenance programme depends on quality of the system components and the environment it is in. If the components are of low quality or the environment is dirty the frequency is higher than when the components are of high quality or the environment is clean.

In addition to cleaning the system, active preventive maintenance also includes maintaining your hard disk. These tasks vary from taking backups to deleting unwanted files. So in general active preventive maintenance is done as:

- Cleaning the system

- Maintaining the hard disk

Let’s look at each of these activities in detail.

1. Cleaning a system - The main idea of cleaning a system is to remove dust and unwanted matter that has settled on the components. Dust can cause problems to your

systems by not allowing components to cool properly thereby reducing the components lifetime, by short circuiting components and by causing corrosion to components which leads to improper connections between components. There is no standard way to clean your system and the methods used changes according to how far you want to clean your system, time constraints and the tools available. Given below are some general steps you could follow when cleaning your system.

- Have all the necessary tool on hand - Collect all the tools necessary for the job. It is a waste of time and sometimes frustrating when you do not have the right tool for the job on hand. This can lead to using the wrong tool and damaging the components. Furthermore it is important to have some bowls to store nuts, bolts, jumpers and small components and boxes to store cables and other components removed from the system.

- Disconnect the PC form the main power source - Remove the PC from the main power source will provide you and your system components protection form electric currents. Furthermore you will not cause electronic damage to the components by accidentally switching on power or plugging in components when the power is on.

- Take you PC to a suitable work area - The area where you are going to clean your system must have a sturdy platform, have adequately illumination, have good ventilation, have enough space to work in and have a main power supply etc.

- Connect the ESD - connect the wrist strap to yourself and the chassis, and ground the ESD mat. Any component that is removed must be laid on the mat to discharge and static electricity.

- Disassemble your PC - Use the appropriate tool to removes screws, chips and other components. Do not be rough and hard on components. If a component is not coming off easily, it means that it is still attached to a screw, lock or clip. It is important to note that components are built to be plugged in and be removed with minimum force. Do not force the issue. When you are disassembling your system take into consideration the time you have to finish the whole job. If you have ample time you may go the extent of removing the motherboard and stripping the chassis to its bare minimum. Do not try to disassemble individual any components which have a warranty sticker on them. Damaging the warranty sticker means that the warranty for that component is void. Whiles you may disassemble individual components like the floppy drive to clean it, it is not wise to disassemble components like your CD/DVD Drives, since these are not meant to be tampered by non-experts. If you don not have a good memory of where each component came from device a method to document each component that you remove to aid you in reassembling the system.

- Clean the components

  - Cleaning boards - Use a soft brush and a vacuum cleaner or a can of compressed air to blow of the dust particles from the boards. Once you have reached a level where no more dust can be blown off, use a lint-free cotton swab dipped in cleaning solution to remove the leftover particles.

  - Cleaning the connectors and contacts - It is important to clean the connectors and the contacts of all the components of the system. Use lint-free cotton swabs dipped

in cleaning solution to clean the connectors and contacts. This will ensure that there is good connection between the components once they are reconnected. It is important to clean connectors and contacts which are in hard to access places like expansion slots. Some of the key connections to clean are: The power connectors, contact on expansion cards and memory, expansion slots and memory slots, hard disk and floppy disk connectors and cables, audio connectors, battery connectors, telephone line and network cable connectors, keyboard and mouse connectors and serial and parallel port connectors.

- Cleaning the power supply - use a brush and a vacuum cleaner to blow off the dust on the power supply fan and air intakes and outlets. There is no requirement to disassemble to power supply to do this task.

- Clean the chassis and fans - use the same method mentioned for cleaning the power supply to clean the chassis. In addition you may use cotton swabs dipped in cleaning solution to clean off any grease or gum form the chassis and fan.

- Cleaning the Keyboard and mouse - The mouse and the keyboard trap dirt and garbage really quickly. You may find dust, hair, paper and sometimes even food inside your keyboard. The best way is to use a brush and a vacuum cleaner to brow off debris on your keyboard and use cleaning solution to wash of any stains, grease or oil. The ball mouse is famous for picking up dirt form the table; the mouse pad reduces this to a certain extent but never irradiates the problem. The ball mouse can be easily unlocked for the bottom and the contacts and the ball can be cleaned using a cleaning solution.

- Cleaning the display - Uses a brush or a vacuum to bowl of any dust or debris on you display. Most monitors have greasy finger marks on the screen which do not wipe of easily. Use a cotton swab dipped in cleaning solutions to wipe the screen and the monitor so that you have a clear display.

- Reassemble the components - Reassemble each component as it was. If you do not remember where a component fits in use the notes you took down when disassembling the system. Remember that not even a single screw can remain once you have reassembled the system. Double check the system to verify proper reassembly. Create a checklist which may look like the one below.

  - Check whether each component is plugged in or screwed in properly (Example: Processor, RAM, Video card and other expansion cards etc.)

  - Check if all the cables are connected and in right order (Example: IDE cables, floppy disk cable and Analog audio cable etc.)

  - Check if the power connecters are plugged in properly (Example: motherboard power, 12V ATX connector, Hard disk, floppy drive, CD/DVD drive power connectors)

  - Check if all the chassis indicators, switches and speaker are plugged in properly

- Check if the cooling fans are plugged into the correct sockets - This is very important since your system could overheat and the components could be destroyed if the fans do not function.
- Make sure there are no stray parts rolling around in the system since these could easily short circuit your system (Example: nuts and bolts, pieces of chopped off wire and tool bits etc.)

- Power-up your system and check for errors. If there are any errors follow the trouble shooting section.

2. Maintaining the hard disk - Maintaining the hard disk is a key factor for high performance of your system. If your hard disk is packed-up and files are cluttered in your hard disk it takes more time for the system to read and write to your hard disk. There are certain precautions you can take to avoid this and bring good performance to your system.

- Backing up data and files - You can use various types of storage devices to backup your data and important files. Large organizations use DAT tapes or servers physically located away from the original data source to backup their data and files. The normal PC user would use floppy disks and in modern days removable hard disks, CD-ROMs or DVD- ROMs to backup their important data and files. The reason for backing up data is that if some physical damage comes upon the original data or file source, the backups can be used to restore the system and avoid the loss of data and files. Backing up is also important in the case of accidental deletion of data or files.

- Delete temporary files and cleanup recycle bin - It is important to clean up all temporary files in your system to avoid your system from being packed-up. Files with the extension ".tmp", ".chk", that begin with the tilde (_) and the web browser history should be deleted periodically. Furthermore the recycle bin must be emptied periodically to avoid unwanted files taking up space in your hard disk and file system.

- Upgrade Anti-virus programme and scanning the system - Virus program can cause severe damage to your computer. From destroying your hardware to your entire file system. It is important to have your virus guard definitions up to date and conduct periodical scans of your system. Most virus guard configuration programs allow you to set your virus guard to auto-update definitions and auto-scan at a particular time. Having regularly updated programs such as Anti-spyware and Anti-adware running on your system would help your to reduce the risk of harm being caused to your system.

- Defragment the file system - The term "defragmenting" means clustering together all fragmented parts of a single file as much as possible to consecutive storage locations on your hard disk. The fragmentation of files occurs when you constantly delete and save file in your hard disk. The advantage of defragmenting is that it improves the performance by reducing the time it takes to read a single file since all the fragments are in consecutive storage locations. Another added advantage is that it reduced the movement of the hard disk head thereby reducing the ware and tare of the hard disk. Defragmenting can be done by running a defragmentation program which most of the time available with the operating system.

- File packing - Another advanced part of defragmenting is known as file packing. Here the files are defragmented and stored in such a way that the free space in the hard disk

is available in consecutive storage locations. Thereby when a new file is stored it can be easily stored in consecutive locations instead of having to be fragmented.

10.1.3.2 Passive preventive maintenance

Passive preventive maintenance implies the provision of physically and an electrically best suited environment for the system. In terms of physically it implies providing an environment free of dust and pollutants, disturbances such as stress and shock, temperature variations and thermal stresses. In terms of electrically it implies providing an environment free of electrostatic discharge, power-line noise and electro-magnetic interference. Let's look at each of the above factors in detail.

1. Physically

- Dust and pollutants - The environment where the system is, should be free of dust and pollutants, smoke, high humidity and corrosive air such as acidic smog or sea breeze. All of these could cause severe damage to your system. You should provide an enclosure where the system can be protected from these elements. Unlike older systems modern systems are more tolerant of these kinds of environments. You can also install air filters which can filter pollutants and dust from the air that is passed through the system. These need to be changed occasionally. If there is no other option and your system is in an environment like this it is important that you clean your system regularly to ensure long and trouble free life of the system.

- Disturbances - Disturbances such as shock and vibrations can cause severe damage to your system. Especially to devices such as hard disks. Furthermore it could lead to components getting loose and cause loss of proper contact with each other. This could also lead electric sparks in contacts which could destroy your components.

- Temperature variations - The variation in the environment temperature can cause damage to your system if the variation is very high. The expansion and contraction of components can lead to cracks in circuit boards, breaking of solder joints and accelerated corrosion of contacts. Keeping you systems exposed to direct sunlight could also lead to problems. One way of avoiding the problem of temperature variation is to use the manufacturer provided specifications for the "On" and "Off" states temperature of the system and creating a suitable environment.

- Thermal stress - The variation of temperature during power-up is much greater than the variation of the environment temperature. Constant turning on and off the system leads to thermal stress and thereby reduces the life of your system. The thermal stress is caused when the temperature rises instantly when the components are powered up. It is advisable to turn on the system only once a day and keep it on all day. If the environmental temperature is very low you should keep them machine on all the time to avoid thermal stress. This might not be possible due to power consumption and the leaving a system On unsupervised, which could be a fire hazard.

2. Electrically

- Static electricity - Static electricity can cause numerous problems to your system. External electrostatic discharge could cause problems like memory errors and make

your system lockup. When handling components an electrostatic discharge could permanently damage the component. Most of the static electricity problems are caused because of improper grounding of the system. It is important to use a three pin plug which has a proper ground connection. When handling components it's advisable to use an ESD wrist strap and an ESD mat which are properly grounded to avoid ESD damage.

- Power-line noise - Noise on power-lines could cause permanent damage to your system. Power drops or power surges can cause your components to dysfunction and could damage your hardware and data. De- vices like laser printers, copiers, heaters and other heavy-duty equipment take up a large amount of power at startup and thereby cause power-line noise. The quality of the main power source is important to avoid this situation. The quality of the main power source could be improved by but not totally overcome:

  – The computer power should have its own circuit with its own circuit breakers

  – Check the power for the correct line voltages, low resistance ground free of interference

  – Use a three wire circuit (Three pin plug)

  – Use of good, reliable and heavy-duty extension cords to provide power. Avoid extension cords altogether if possible. Reduce thircuit resistance by using thick and short wires, since power line- noise causes high resistance in circuits.

  – Limit the number of equipment you plug into the same outlet.

  – Use power regulators, power guards and uninterrupted power supplies (UPS) (figure 10.13) to overcome power-line noise.

  – If you have laser printers, copiers etc. turn them on before you turn on your system.

  – Avoid using the system at times when you know there is power-line noise.

- Electromagnetic (EM) interference - EM interference is caused by electromagnetic waves of in other words radio waves. These can cause nice in input and output devices, corrupt memory which could lead to sys- tem lockup. Finding solutions to EM interference is hard since each case is different from the other. Some solutions are:

  – Have special EM insulated cables

  – Pass the cables through a toroidal iron core (figure 10.14)

  – Keep radio equipment away from you system

Figure 10.13: UPS

10.2 Troubleshooting guidelines

There is no set of clearly defined rules that you could use to troubleshooting a PC. Troubleshooting is a form of problem solving. It is a systematic way finding and eliminating the possibilities until the root of the problem is isolated. Some deductive reasoning and logical thinking with a little bit of knowledge about the functionality of the components and errors that could occur could help you find the fault. With some components comprising of millions of transistors and with so many components connected to the computer system, the fault could be anything and in one or more of the components. Therefore it is important to be logical and systematical in finding the faulty part.

Another method of trouble shooting is to use PC diagnostic software. Diagnostic software can play a vital role when ever your system malfunctions, when upgrading or building a new computer system. They will help you identify and pinpoint problems to a certain level of accuracy. It is important to note that these software may not be a hundred percent accurate due to the complicated nature of hardware.

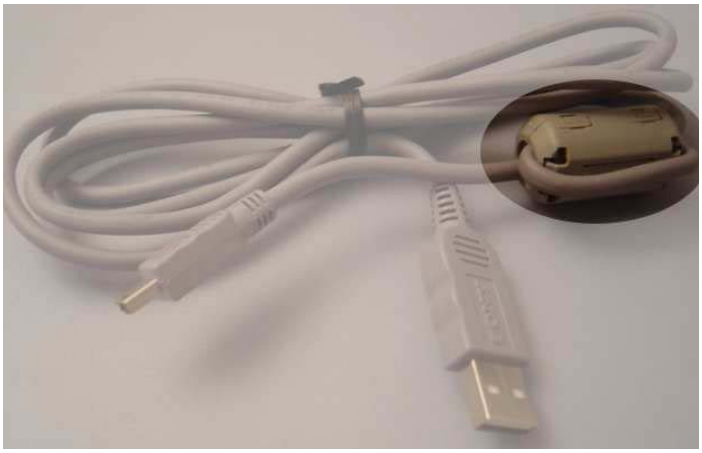

Figure 10.14: Toroidal iron

With advancement of computer hardware and software, and with hardware becoming more and more complex, the best troubleshooters are not the people who know all the errors and the functionality of the parts, but the people who have hands on experience. Experience is the key to being a good computer system trouble shooter.

With the circuits becoming more and more complex, much more compact and lower in cost, the concept of repairing individual components has given way to the concept of replacing the faulty component. So what troubleshooting now is to find the faulty part and replace it rather than find the faulty part and to repair it. The computer industry is standardized to a great extent. This implies that most manufactured components adhere to standards and therefore are interchangeable with other systems. This has also lead to cheaper, commonly available and easy to install hardware components.

10.2.1 Diagnostic Software

Diagnostic software comes in many different forms.

- Hardware embedded - Hardware embedded diagnostic software helps to diagnose hardware issues. If the software is embedded on the device itself, it will diagnose the problems of that particular device. The software that is embedded on the ROM of the Video graphics adapter card is an example of this kind of diagnostic software. It checks whether the video graphics adapter card function properly. The network interface card too has diagnostic software to check test various functionalists of the network interface card.

It is important to note that there are software that are embedded in devices like motherboards and expansion cards that diagnose and test itself and other secondary devices that are connected to it. The Power on Self Test (POST) that is embedded on the motherboard ROM is the most common of these. Another is the diagnostic software that is embedded on SCSI host adaptors. In addition to diagnosing themselves they also diagnose other devices connected onto them.

- Included in the operating system - There are diagnostic software that are included in the operating system that can diagnose, monitor and test a large number of different devices and the resources shared by those devices.

- Hardware manufacturer supplied - These software are supplied by the device manufacturer and have to be installed on the computer system. They are designed to diagnose and test specific devices. These diagnostic software are custom designed hence provide a very comprehensive diagnostic report for a particular device. Computer manufacturer like IBM, Dell, Hewlett- Packard, Toshiba and Sony provide software that can diagnose, test and monitor the entire computer system they provide.

- General-purpose - These are software supplied by a third party software manufacturer. These software can diagnose a wide range of devices of different manufacturers. Some of theses software are designed to diagnose only a specific type of device, for example like memory testing software. Others like SIS-Sandra and AMIDiag Suite are examples for software that can test and monitor almost all devices that are connected onto your computer system.

10.2.1.1 POST

The Power on Self Test as the terms suggest, is run when the computer system is powered up. The POST is the first program to be executed and is loaded from the
BIOS ROM of the motherboard. The POST tests the main system components of a computer system. The system will not boot-up without the set of routines in the POST being executed and the test reports that all the main components are working properly.

There are some key issues when discussing the POST, they are:

- What are the main components tested by the POST - The main devices tested by the POST are the CPU, motherboard support circuits, ROM, Main memory, Video graphics adapter which is connected to the primary output device, keyboard which is the primary input device.

- What does the POST do if an error is found - The POST will halt the progress of the boot-up and gives an error. It will only allow the boot-up process to continue in the case of the keyboard malfunction. It will halt on all other errors. It will continue on a keyboard malfunction only after it displays a message which request for your consent to continue.

- How does POST indicate errors - The errors may be in the form of a beep codes (audio codes) or on screen messages (text) or check point codes (a hexadecimal value sent to an I/O port address).

  – Beep codes - The number and the length of the beeps (long and short) indicates the fault with a particular component. These are errors indicated when it is not possible to display a text message. Examples for these are when the CPU or main memory or video graphics adapter does not function. The beep codes differ according to the BIOS manufacturer. For example 1 long and 2 or 3 short beeps indicate Video card error in AWARD BIOS, but 1 long and 3 short indicates a memory error in the AMI BIOS. It is important to know the beep errors of for the BIOS your system is using. The descriptions of the messages and the codes are usually available in the motherboard manual.

  – On screen messages - These messages give a description of the error. It is much easier to find the fault with these errors. The error message consists of some description and an error code. These error messages are shown for components that are tested after initialization of the video graphics adapter. Like beep codes different BIOS manufacturers have different messages and codes. The descriptions of the messages and the codes are usually available in the motherboard manual.

  – Checkpoint codes - These are hexadecimal values sent to an I/O port address. These require a special adapter card that is plugged into a system expansion slots. These checkpoint codes are also referred to as POST codes. These cards are not common among ordinary computer users.

- What do you do if an error occurs - You could use the motherboard manual or an online resource to find what is the most likely cause for the error indicated by the BIOS. You could next try reinstalling the component that is most likely causing the error. Before

installing it in necessary to check for any damage and clean the contacts of the component. If this does not correct the problem try using a spare to replace the component you suspect is the cause of the error. If it corrects the error then it is usually a fault of the replaced component. If the error continues it could be a fault of another component.

10.2.2 Procedure to make troubleshooting more successful

1. Turn off the computer system and any peripheral (external) devices. Disconnecting devices when the computer system or the device is on could permanently damage the computer system or the device.

2. Disconnect all peripheral devices form the system except the keyboard which is the primary input device, and the monitor which is the primary output device. The reason for this is to create a standard starting point for trouble shooting. Any peripheral devices connected to the computer system could created a different start point an interfere with the troubleshooting process.

3. Connect the computer system to a power source with correct voltages and proper grounding.

4. Make sure that the video graphics adapter, monitor and the keyboard are connected properly and functioning.

5. Check whether the video graphics adapter is plugged in correctly and the monitor has proper contrast and brightness.

6. Select what device you want the system to boot from. If it is the CD drive or floppy drive, make sure a functioning boot CD or floppy disk is in the drive. If you want to boot from the hard disk make sure that there are no bootable disks in the floppy drive or the CD drive. You might have to change the BIOS start-up configuration to select the primary boot device.

7. Observe the fans, chassis indicator LEDs, monitor, keyboard LEDs and splash screens and messages displayed on screen.

8. Listen to the beep codes and error massages displayed on the screen. I you are not sure of the errors you may refer the motherboard manual or a book or an internet resource.

9. Observe whether the boot up process executes successfully.

10.2.3 Trouble shooting using deductive reasoning

We addressed the issue of using diagnostic software to find the faulty component and troubleshoot. Now we address the issue of using deductive reasoning to fin the faulty component. Listed below are some of the components that can b faulty and replaced. These components adhere to industry standards and ca be used to replace a faulty part most of the time. It is important to note that there might be compatibility issues when attempting to replace

the component For example you when you attempt replace a Pentium 4 2.4GHz processor with a Pentium 4 3.2GHz processor, the motherboard has to support the new processor.

- Processor - the motherboard has to support the particular processor (Pentium 4 processor with higher speed are not supported by some older Pentium 4 motherboards)

- Motherboard - the processor, RAM and power supply etc. have to be compatible with the new motherboard

- Main Memory (RAM) - The RAM should be of the same type as the RAM being replaced unless the motherboard has different slots for different types of main memory (for example you cannot plug in a DDR RAM to a SD RAM slot)

- Chassis - The chassis should be of the same form factor as the mother- board and power supply and have enough space to contain all the existing components

- Power supply - The power supply should be the same form factor as the motherboard and chassis

- Video card - The motherboard should support the video card (for example the 8X AGP card is incompatible with a 4X AGP port) and the monitor should be compatible with the video card

- Sound card - The sound card needs to be compatible with the interfaces available on the motherboard

- Network card - The motherboard and the network the computer system is connected to should support the network card

- Hard disk - The hard disk should be supported by the motherboard and the BIOS (for example some motherboard do not have SATA support and old BIOS version do not support more than 8Gb hard disks)

- CD and DVD ROM/RW drives

- Floppy drives

- Keyboards - The Keyboard needs to be compatible with the interfaces avail- able on the motherboard

- Mouse - The mouse needs to be compatible with the interfaces available on the motherboard

- Speakers - The speakers should be supported by the sound card

- Monitor - The monitor should be supported by the video graphics adapter

- CPU heat-sink and fans - These should be compatible with the CPU

- CMOS battery - This has to be the same model or an equivalent model to the original battery (figure 10.15).

Figure 10.15: CMOS battery

- Drive cables - This should match the technology used by the motherboard and the drives

Some of these components might be on the motherboard itself (on-board). For example the video graphics adapter, sound card and network card might be embedded on the motherboard. In the case of diagnosing that one of these components is faulty, you cannot replace the component by removing it. To rectify the problem you need to disable the component on the motherboard from the SETUP program and then install a new card which is compatible with the motherboard.

10.2.3.1 Reinstalling

The reason of the fault in most cases is that the component has not been installed properly. This could imply that the component is incorrectly installed physically, or the driver or the files used by the system have not been installed correctly or have been corrupted. There for before you replace a component try physically reinstalling the component after cleaning its contacts and then try reinstalling the drivers and the files used by the component. If this does not succeed then you can move on to the next step of using a spare to find out if the fault is really with this component or another. If the trouble persists it is likely that the fault lies in a different component.

Another reason for attempting reinstalling is that some of the devices and chips become obsolete and the manufacturer stop their production. In a situation where it is not possible to get a spare the only option is to reinstall the component. If this does not rectify the problem you have to replace certain sets of components which have compatibility problems. It is important to note that some of the components may be still usable with the newly replaced components, so you do not have to incur the full cost for a brand new computer system. An example for this is that you might have a Pentium III system. If you find that the fault is with the motherboard, you might find that motherboards that support Pentium III processors are not manufactured anymore and finding replacement is hard. Therefore you could go for a Pentium 4 processor and a compatible motherboard. It is most likely that you could use your main memory hard disk, video card, CD/DVD Rom, networks card, chassis, sound card and floppy drive etc.

10.2.3.2 Replacing

If a component is faulty even after reinstalling it, the next step you can take is to replace the part to try to figure out whether the fault is in the particular component or another component. To replace a component you require a component that is known to be working properly. Most computer repair and service centers have a collection of components that they know for sure are working correctly. They can easily swap the replace the component and verify whether a component is faulty or not.

When it is the case where you are attempting to troubleshoot your own computer it is not likely that you would have a complete set of spares you know are working correctly. In this scenario you will have to borrow a similar spare component that you know works correctly form another computer. It is not a must that the components be identical to each other since most devices follow the industry standards. If the problem is solved by replacing the component it can be deduced that the problem is in the particular component. If not it leads to two possible scenarios.

1. The fault is not in the particular component but in another component

2. The fault may be in the particular component as well as another component

If you suspect that the fault is in the particular component you could install the component into another computer system which you know works correctly. If the component work it means that you are facing the first scenario. If the particular component does not work in the system you knew was working correctly it means that you are facing the second scenario.

In any of the above two scenarios you need to search for more clues to find out what other device could be contributing to the failure of the computer system. If there are no clues you need to think of the most likely component that could be related to the problem. This is where your knowledge about the functionality of hardware components and your troubleshooting experience becomes invaluable. Once you identify the second component causing the problem you can try replacing it. If it solves the problem you know what part is at fault. This methodology can be used until you find the root cause of the problem. By eliminating possible faulty components by using deductive reasoning and logical thinking you could troubleshoot your computer system.

10.2.3.3 Building up the system while troubleshooting

This is the most appropriate method when you have a system that is not functioning at all (a dead system). This method of troubleshooting follows some general steps.

1. Dismantle the computer to its individual components.

2. Clean the components using the methods described in section.

3. Put together only the basic components required for the system to work. These include:

    - Motherboard

    - Processor, Heat-sink and cooling fan

- Main memory
- Video graphics adapter card
- Keyboard
- Monitor
- Chassis and Power supply

4. Reload the BIOS Setup defaults and Configure the BIOS Setup program

5. Power up the system - If you get any beep errors or error messages try re- placing the part accordingly. If your computer system completes the POST routine and displays it you could assume that the CPU, motherboard, memory, power supply, the video graphics card and monitor functions properly. If the keyboard LEDs (NumLock, CapsLock, ScrollLock indicators) blink it means that your keyboard functioning correctly.

6. Once you verify that the main components work you could try adding one component at a time and checking whether the system works.

7. This can process of adding one component at a time can be repeated until you find the component which is faulty. When troubleshooting in this manner there are some important factors to keep in mind.

    - Keep notes of the components you add and the changes you make.
    - Do not overlook even the smallest possibilities.
    - Cables and connector can be the cause of problems. Try replacing them.
    - Recheck the connection and configuration two or three times.
    - Do not give up.

10.3 Upgrading a system to new requirement specifications

In this section we address the issue of upgrading a system according to a specific requirement. Before we address the issue of specific requirement let us look at the basics of upgrading a computer system.

10.3.1 Upgradability

Upgradability refers to the fact of to what extent a computer system can be upgraded (improved). When we purchase a new system it is important to consider the upgradability of it. Computers are considered a high investment and with the computer industry changing rapidly a

computer bought today might be obsolete in three to six months. Therefore upgradability is a factor when you purchase a new computer system.

Purchasing of a computer system can be done form a larger system vendor like IBM, Dell or Hewlett-Packard etc., or you could purchase individual components and build your own system. There are advantages and disadvantages in using either of the two methods. The advantage of purchasing form a larger system vendor is that in most cases you receive a fully warranted system with service. Furthermore you get an original copy of the operating system which is customized for the particular computer system. You would also get special software from the manufacturer or a third-part for free. Since original software are highly priced, you save a large amount of money when you purchase such a system. Another advantage is that the components are fully compatible with each other. The disadvantage of purchasing computer systems from a larger system vendors is that those systems have very limited or no upgradability due to the reason that most of them use proprietary components.

An advantage of purchasing components and building your computer system is that you can decide on what components and configuration you want. You also have a great amount of flexibility when upgrading your system. You could easily replace old or obsolete components with new and better components. The disadvantages are that you do not get a full system warranty or service and you need to spend extra for software. Furthermore the components you purchase may not be fully compatible with one another.

10.3.2 Upgrading

Upgrading a computer system can be done from several views points of the computer system. Sometime to upgrade your system according to a specific requirement you might need to consider one or more of these. Some of these viewpoints are listed below.

1. Processing power - The common measure of processing power is usually the clock speed of the processor. In addition to this other factors like the enhanced features of the processor, bus width and hyper threading capabilities etc. can influence the processing power of the computer system. When we upgrade the processor it is important to consider the compatibility of the existing motherboard, main memory and the power supply etc. Some processor upgrades might require you to change the motherboard, main memory, power supply and sometimes even the chassis.

2. Memory available for processing - If you want to add more memory or a different type of memory to your computer it is important to consider the number of free memory slots available and whether the motherboard supports the particular type of memory. If you want to add memory but do not have a free memory slot you might have to give up your old memory modules and purchase modules with higher capacity.

3. Storage capacity - Usually adding storage is not a complicated task. If you have a free drive interface for a new hard disk that is all that is required. The only issue could be that the motherboard BIOS may not support large capacity hard disks. This can be rectified by upgrading the motherboard BIOS.

4. Graphic capabilities - Graphic capabilities can be enhanced by replacing the existing graphics card with a more powerful graphics card. When replacing the graphics card it is

important to note the type of slot it connects to (PCI, Enhanced PCI or AGP), its speed (2X, 4X or 8X) and it's video memory.

5. CD and DVD capabilities - The CD and DVD capabilities can be upgraded according to your requirement. You might want to replace your CD-ROM drive with a CD-RW drive or a DVD-ROM drive or a DVD-RW drive, or you might want to add a new drive. May be you might want to upgrade your DVD/CD-RW combo drive to a DVD-RW. The upgrade changes according to your requirements. The only requirement for this is that your computer system has a free drive interface.

6. Audio capabilities - Upgrading of your Audio capabilities can be simply done by connecting a sound card or speakers with better capabilities. This is one of the most simple upgrades and usually do not require a change of other components.

7. Display - The display can be upgraded in many ways. The CRT display could be replaced with the larger CRT display or an LCD display. The only consideration is that the video graphics adapter card must support the new display device.

8. Interfaces - Upgrading interfaces can be done most of the time by adding an expansion card which has the upgraded interface. For example if your computer does not have a FireWire port you can add a FireWire interface card. Another example is that if your computer only has USB 1.1 ports, you could add a USB 2.0 interface card. It is important to note that the interfaces on the motherboard cannot be upgraded, if you need more advanced interfaces than the existing once you might have to add expansion cards like mentioned above or replace the motherboard.

9. Computer software - Upgrading computer software has some consideration on the existing hardware and software of the computer system. The hard- ware factor is that the existing hardware might not meet the minimum hardware requirements of the upgraded software. The software consideration is much wider. Some of them are listed below.

- When upgrading the operating system some of the older software might not work with the new operating system.

- When upgrading application software, the old operating system might not support the new application software.

- When upgrading application software, some of the older files still used by other application software might be overwritten. This means that the older application software is most likely to malfunction.

Considering a specific requirement

We have to consider both hardware and software upgrades according to a specific requirement. The hardware upgrade usually does not affect the software but is likely to affect other hardware and may require an additional hardware up- grade. In most instances a software upgrade is likely to affect both software and hardware. Due to this you might need to consider both software and hardware upgrade.

When considering a hardware upgrade you need to consider doing the upgrade in a manner that would not require much change to your existing hardware components. For example if you are doing a processor upgrade it is most likely that you might need to change the motherboard. You can try to select a compatible motherboard that supports your existing chassis and power supply, main memory and other components. Reuse of other components has to be balanced with the considerations of supporting future upgradability. In the above example you might find that the main memory you are reusing is obsolete and you might find that future memory upgrades are impossible. If in future you need a memory upgrade you have to change the motherboard. Is a scenario like this you might consider upgrading the processor, motherboard and main memory so that you create a possibility for future upgrades.

When considering a software upgrade you have consider whether the new software is compatible with other software you use and whether your hardware meets minimum hardware requirements of the new software. Looking at the upgrade from a software point of view, if you are installing a realistic 3D game you might want to consider whether the operating system supports the new game or whether the operating system needs to be upgraded. You also need to consider whether the version of files shared between the new software and the existing software are similar. For example the new game might use DirectX 10 and another existing game might use DirectX 9. If there is share file mismatch you might have to consider finding the newer version of the existing software using the shared files.

In the second example of the realistic 3D game, your hardware might not support the minimum hardware requirement of the new game. In this case you might have to upgrade the processor or the main memory or the video graphics adapter (VGA) card or any combination of the three. During the upgrade of the processor you might need to change the motherboard and main memory like the first example. If you are upgrading memory you might have to add to or replace the existing memory modules with higher capacity memory modules. If you need to upgrade the VGA card you might be able to upgrade the video memory. In the case of the VGA card being of higher speed than the Accelerated Graphics port (AGP) of the motherboard you will need to upgrade your motherboard to accommodate this VGA card.

The above examples clearly show that upgrading a system to new requirement specifications is a careful balancing act between making the upgrade cost effective and maintaining future upgradability. You have to think into the future when you are considering an upgrade.